

### The Effect Of Three Techniques For Soft Tissue Mobilization On Softball Pitching Biomechanics

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Soft tissue mobilization (STM) is commonly performed by athletic trainers in collegiate sports; it can be implemented in a variety of ways. How different STM techniques influence subsequent biomechanical function is unexamined.

**PURPOSE:** To evaluate the effect of various STM techniques on windmill pitching kinematics in collegiate softball.

**METHODS:** 10 Division 1 softball pitchers underwent 4 testing periods involving an STM session followed by mechanical evaluation of a windmill pitch using a Proteus device (Proteus Motion, USA). The different STM options were: active release technique (ART), cupping therapy (CT), instrumented-assisted mobilization (IAM), and a comparison group receiving no treatment (control). The STM methods were conducted in a random order with 48 hours separating each test. Immediately after STM, players performed 8 maximal-effort windmill pitches on Proteus (3 acclimation repetitions followed by 5 analyzed pitches). Proteus calculated power (watts), explosiveness (watts/sec), endurance (percent maintenance of power in serial repetitions), range of motion (ROM; distance traveled in 3D space), and consistency (replication of range of motion). Repeated measures ANOVAs evaluated differences in Proteus outputs in the different STM trials.

**RESULTS:** Subjects were  $19.4 \pm 1.1$  years old, height was  $64.5 \pm 5.5$ in, weight was  $150.4 \pm 15.3$ lb, arm length was  $67.1 \pm 3.4$ in, and mean pitching experience was  $5.2 \pm 4.3$  years. Proteus performances following the control treatment were: power of  $30.8 \pm 2.9$ , explosiveness of  $27.3 \pm 8.3$ , endurance of  $90.4 \pm 4.7$ , ROM of  $6.4 \pm 1.0$ , and consistency of  $80.3 \pm 10.5$ . ANOVA demonstrated non-significant patterns ( $p > 0.150$  compared to control) in which the ART testing had the highest subsequent power ( $32.5 \pm 4.2$ ), explosiveness ( $29.2 \pm 7.9$ ), and consistency ( $81.0 \pm 12.8$ ), and IAM had the highest endurance ( $92.9 \pm 3.7$ ).

**CONCLUSIONS:** In a small, pilot sample of 10 softball pitchers, no STM method emerged as superior to the others or to the control group. Being the first investigation of its kind, further analyses on larger samples and in diverse athletic contexts are warranted to identify possible performance aids available to athletic trainers.

### Development Of OA Following ACL Reconstruction: Unexpected Finding In Medial Versus Lateral Meniscus Pathology

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**PURPOSE:** Recent studies have described increased risk of OA following ACL reconstruction (ACLR). Systematic reviews have suggested that meniscal pathology, which occurs in up to 60% of patients with ACL injury, increases this risk. The purpose of this study was to determine the incidence of OA following lateral meniscus repair versus partial lateral meniscectomy in patients with ACLR.

**METHODS:** All patients who underwent primary autograft or allograft bone-patellar tendon-bone (BPTB) transtibial ACLR by a single surgeon between 1999-2018, were identified. Revision ACLR, multi-ligamentous reconstructions, and patients with less than 2-year imaging follow-up were excluded. Patients with lateral meniscus pathology at the time of ACLR were identified and treatment (e.g. lateral meniscectomy or lateral meniscus tear) was extracted. OA was defined at follow-up as Kellgren-Lawrence (KL) grade III-IV on plain radiographs. Chi-square tests assessed differences in incidence rates ( $p < 0.05$ ).

**RESULTS:** A consecutive series of 107 patients (55 males, 52 females; age  $35.9 \pm 11.9$  years) with BPTB ACLR were included with an average follow-up of  $8.9 \pm 5.0$  (range 3-21 years). The prevalence of lateral meniscus tears was 59.8% (64/107). 14 of 51 (27.5%) patients that underwent partial lateral meniscectomy developed lateral OA compared to 0% of patients (0/13) that underwent lateral meniscal repair ( $p=0.0340$ ). Patients that underwent lateral meniscectomy have a 27.5% chance of developing lateral OA; a 6.2 times greater risk compared to patients that underwent lateral meniscus repair. Tear morphology, tear location, and tear zone were not found to be associated with the development of lateral OA in patients with lateral meniscus tears (all  $p > 0.0623$ ).

**CONCLUSIONS:** Patients with lateral meniscal tears should be informed they have a 27.5% chance of developing grade 3-4 OA in the lateral compartment following lateral meniscectomy at 9 year-follow up. In contradistinction, successful lateral meniscus repairs substantially decrease the risk of OA in the lateral compartment. We believe lateral meniscal repair is essential for lateral meniscus tears at the time ACL reconstruction to help avoid development of OA.

### Associations Between Physical Fitness Test Scores And Tibial Bone Microarchitecture In Young Adults Entering Military Training

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Participation in physical activity (PA) leads to more robust bone microarchitecture and decreased risk of bone stress injury (BSI); a common injury during U.S. Army Basic Combat Training (BCT). As self-reported PA may be subject to recall bias, objectively measured physical fitness (PF) may provide new insights into the relationship between PA and skeletal health.

**PURPOSE:** To assess the association between objectively-measured PF and bone microarchitecture in young adults entering BCT.

**METHODS:** We obtained high resolution peripheral quantitative computed tomography (HRpQCT) scans to assess distal tibia microarchitecture and Occupational Physical Assessment Test (OPAT) scores from U.S. Army accession records for 1141 men and 630 women at BCT entry. The OPAT consists of a strength deadlift (SDL), standing long jump (SLJ), seated power throw (SPT), and interval aerobic run (IAR), each scored 1 (best) to 3 (worst). Scores in each event were summed and grouped to create low (LOW), moderate, and high (HIGH) PF groups for overall score, cardiorespiratory (CR; IAR score only) and strength/power (S/P; summed SDL, SLJ, and SPT scores) components. We used linear regression models to determine the relationship between PF and bone parameters, adjusted for age, race/ethnicity, and BMI.

**RESULTS:** Men and women enrolled in the study were healthy, young ( $20.8 \pm 3.7$  yrs) and had normal BMI ( $24.7 \pm 3.6$  kg/m<sup>2</sup>). Cortical area (Ct.Ar) and thickness (Ct.Th.) were significantly higher in both men (Ct.Ar = 6.9%; Ct.Th.=6.0%) and women (Ct.Ar.=7.1%; Ct.Th.=5.6%), in HIGH vs. LOW ( $p < 0.01$  for all). Total volumetric bone mineral density (vBMD) (4.3%), trabecular (Tb.) vBMD (5.0%), and Tb. thickness (1.9%) were higher in men ( $p < 0.02$  for all) in HIGH vs. LOW, but there were no significant differences in HIGH vs LOW women. When CR and S/P were assessed separately men and women in the HIGH groups had significantly greater measures of Ct. bone parameters vs. LOW; only men had significantly greater Tb. bone parameters.

**CONCLUSION:** Bone microarchitecture was more favorable for individuals with better PF test scores, with the overall OPAT score most strongly associated with favorable bone microarchitecture. Ongoing work will determine whether individuals scoring higher on the OPAT at BCT entry have lower risk for BSIs.

### Sex Differences In Bone Metabolism During An Arduous Military Field Exercise

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Military personnel are often exposed to arduous exercise and energy deficits. Acute and severe periods of energy deficit increase bone resorption and decrease bone formation. Evidence for the effect of energy deficit on bone metabolism in military personnel is limited, and sex differences in these responses are unknown.

**PURPOSE:** To investigate sex differences in bone metabolism during an arduous military field exercise.